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Low-Frequency Anomalies in spectral Ratios of Microtremors above and nearby Hydrocarbon Reservoirs: A Case Study in Austria

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The movements of the Earth surface generated by the omnipresent ambient seismic background noise, and their corresponding Fourier spectra for frequencies above 1 Hz are usually referred to as microtremor. We investigate spectral ratios of the microtremor wave field in the low frequency range ($<$ 10 Hz) above and nearby hydrocarbon reservoirs. The spectral ratios are calculated from the different components of ground motion measured at single stations. We give a brief overview of methods to calculate the spectral ratio of the horizontal (H) to vertical (V) particle velocity component (i.e. H/V-ratio) which can be used to assess the S-wave velocity profile for shallow geological structures. We elaborate the spectral ratio technique to detect and characterize hydrocarbon bearing structures. Our focus is on the peak amplitude of the V/H-ratio, and we map this amplitude along three profiles across an oil and gas field near Voitsdorf, Austria. Characteristic variations across the hydrocarbon reservoir are observed, namely that higher values and larger variations of the peak amplitude occur above the reservoir. The results of this case study indicate that spectral ratios of microtremor may contain useful information to detect and characterize hydrocarbon bearing structures in the subsurface. However, the physical mechanisms creating such phenomena are not yet well-established. Several possible explanations such as for example higher mode resonances (standing waves) between the reservoir and the Earth surface are currently under discussion. We use a 2D numerical (FD) wave propagation model in order to make one step further towards a physical explanation of the observed anomalies in the microtremor wave field.